UTAH
BIGHORN SHEEP
STATEWIDE MANAGEMENT PLAN

UTAH DIVISION OF WILDLIFE RESOURCES
DEPARTMENT OF NATURAL RESOURCES

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STATEWIDE MANAGEMENT PLAN FOR BIGHORN SHEEP

I. PURPOSE OF THE PLAN

A. General

This document is the statewide management plan for bighorn sheep in Utah. The plan will provide overall guidance and direction to Utah's bighorn sheep management program. The plan assesses current information on bighorn sheep, identifies issues and concerns relating to bighorn sheep management in Utah, and establishes goals and objectives for future bighorn management programs. Strategies are also outlined to achieve goals and objectives. The plan will be used to help determine priorities for bighorn management and provide the overall direction for management plans on individual bighorn units throughout the state.

B. Dates Covered

The plan was approved April 2008 and will be in effect until April 2013.

II. SPECIES ASSESSMENT

A. Natural History

Bighorn sheep are found in the western U.S. from central British Columbia to Mexico and from California to the Dakotas and are one of the most impressive large mammals in North America. They are named for the massive horns grown by the males of the species. Horns grow throughout life and reach maximum size at 8 to 10 years of age. Females also have horns about the size of yearling males. Males, females, and young of the year are called rams, ewes, and lambs respectively. Rams normally separate themselves from groups of ewes and lambs, except during the breeding season, which occurs from mid October to early December. During that time, rams engage in impressive head butting clashes to establish dominance. Gestation is about 180 days. Lambs, which are nearly always singles, are born in mid April to early June.

Bighorn sheep are native to Utah. Archeological evidence indicates they were well known to the prehistoric inhabitants of Utah, since bighorns are depicted in pictographs and petroglyphs more than any other form of wildlife. Historical records of the first white men in the state also confirm the presence of bighorns. Father Escalante noted in his journal as he crossed the Colorado River in Utah - "through here wild sheep live in such abundance that their tracks are like those of great herds of domestic sheep" (Rawley 1985). Explorers, trappers, pioneers and settlers also recorded numerous observations of bighorn sheep throughout the state. Rocky Mountain bighorns *(Ovis canadensis canadensis)* are generally recognized to have inhabited northern and central Utah, whereas desert bighorns *(Ovis canadensis nelsoni)* were found in southern Utah. California bighorns *(Ovis canadensis californiana)* historically inhabited portions of the Great Basin in Nevada and Idaho. Although it is not known conclusively whether or not California bighorns inhabited Utah, recent studies indicate there is no genetic or taxonomic distinction between Rocky Mountain and California bighorns (Ramey 1993). Thus, they should both be considered

the same subspecies (Rocky Mountain bighorn sheep). Some mixing and interbreeding of Rocky Mountain and desert bighorns likely occurred where their ranges converged in Utah, making a clear distinction of historic ranges difficult.

Native populations of Rocky Mountain bighorn sheep were nearly extirpated following pioneer settlement. A few scattered sighting of bighorns persisted in northern Utah as late as the 1960's. Factors contributing to their demise included competition with domestic livestock for forage and space, vulnerability to domestic livestock-borne diseases, habitat conversions away from native grasslands towards shrub lands due to excessive grazing and fire suppression, and unregulated hunting (Shields 1999).

Utah's desert bighorn sheep populations also struggled to survive civilization. Whereas some herds suffered early extirpation, others remained relatively unexploited until the 1940's and 1950's, when uranium was discovered on the Colorado Plateau. By the 1960's, only a small population of desert bighorns remained in Utah along the remote portions of the Colorado River. Desert bighorn populations were thought to have declined for the same reasons as Rocky Mountain bighorns.

B. Management

1. DWR Regulatory Authority

The Utah Division of Wildlife Resources (DWR) presently operates under authority granted by the Utah Legislature in Title 23 of the Utah Code. The Division was created and established as the wildlife authority for the state under Section 23-14-1 of the Code. That Code also vests the Division with its functions, powers, duties, rights, and responsibilities. The Division's duties are to protect, propagate, manage, conserve, and distribute protected wildlife throughout the state.

The Utah DWR is charged to manage the state's wildlife resources and to assure the future of protected wildlife for its intrinsic, scientific, educational, and recreational values. Protected wildlife species are defined in code by the Utah Legislature.

2. Past and Current Management

Utah DWR, in partnership with local conservation groups including the Foundation for North American Wild Sheep (FNAWS) and Sportsman for Fish and Wildlife (SFW), has been involved in an aggressive program to restore bighorn sheep to their native habitat for over 40 years. Extensive efforts have been made to reintroduce and supplement populations of both Rocky Mountain and desert bighorn sheep. Rocky Mountain bighorns were first reintroduced into the state near Brigham City in 1966, whereas desert bighorns were first reintroduced in Utah in 1973 in Zion National Park. Since restoration efforts began, over 900 Rocky Mountain bighorn sheep (including 190 California bighorn sheep) and over 700 desert bighorns have been released in areas of historic habitat (Table 1). Most desert bighorn transplants have been successful, whereas there have been some failures of Rocky Mountain bighorn transplants. Although the exact reasons behinds the transplants failures are unknown, disease issues are thought to be a major contributor.

Current management practices include extensive transplant projects, population surveys, research, and habitat management. Bighorn populations are regularly monitored by helicopter and ground surveys to determine herd size, productivity, and composition. Utah DWR, in conjunction with Brigham Young University, Utah State University, FNAWS, and SFW, has conducted and participated in many bighorn sheep research projects. Findings from those research projects have greatly improved the current knowledge of bighorn sheep and have improved management practices.

Habitat management practices include buy-outs or conversions of domestic sheep grazing permits, vegetative treatments, and water developments. FNAWS and other conservation groups have been extremely helpful in negotiating, funding, and participating in habitat projects.

C. Habitat

Bighorn sheep are uniquely adapted to inhabit some of the most remote and rugged areas in Utah. They exist in some of the most hostile climatic conditions ranging from the hot, dry canyonlands of southern Utah to the cold, snowy alpine regions of Utah's northern mountains. Bighorns are sometimes referred to as a wilderness species because of the naturally remote and inaccessible areas they inhabit. However, recent transplants along the Wasatch Front have shown than bighorn sheep populations can exist in close proximity to humans.

Bighorns prefer open habitat types with adjacent steep rocky areas for escape and safety. Habitat is characterized by rugged terrain including canyons, gulches, talus cliffs, steep slopes, mountaintops, and river benches (Shackleton et al. 1999). Most Rocky Mountain bighorns have seasonal migrations with established winter and summer ranges, whereas desert bighorns generally do not migrate.

Sheep habitat in North America is highly varied but is characterized by an open landscape and stable plant communities in which grasses predominate (Geist 1971). The diet of mountain sheep is primarily grasses and forbs, although they may utilize shrubs depending on season and availability.

Extensive historic bighorn habitat occurs throughout Utah. However, not all habitat is currently suitable for reestablishment of bighorn populations. Vegetative changes, human encroachment, and continued domestic sheep grazing make some areas unsuitable for bighorn restoration. Opportunities for future bighorn expansion are limited due to habitat availability and suitability. Habitat evaluations including Geographic Information Systems (GIS) modeling and on-ground assessments should be conducted to identify and prioritize new release sites prior to release of bighorns.

D. Population Status

1. Rocky Mountain and California Bighorns

Rocky Mountain bighorns currently exist in the northern half of the state (Fig. 1). All of those

populations are the result of transplant efforts. The current population estimate for Rocky Mountain bighorns in Utah is approximately 1900 sheep (Table 2). Of those, approximately 450 are found on National Park Service or tribal lands. California bighorns currently exist on Antelope Island State Park, the Newfoundland Mountains, and the Stansbury Mountains (Fig. 1). The current population is estimated at 400 sheep.

2. Desert Bighorn

Desert bighorns inhabit southern Utah and are more abundant than Rocky Mountain bighorns (Fig. 1). Significant populations occur across the Colorado Plateau including the San Rafael Swell and throughout the Colorado River and its many tributaries. The current population estimate for desert bighorns in Utah is 3100 sheep (Table 2). Of those, approximately 1000 are found on National Park Service or tribal lands.

III. ISSUES AND CONCERNS

A. Disease

Parasites and diseases are a major concern for bighorn sheep management in Utah. Parasites such as those that cause Psoroptic mange (Boyce and Weisenberger 2005) and respiratory diseases such as Pasteurellosis have resulted in large-scale populations declines in short periods of time (Jessup 1985, Foreyt 1990). Pasteurella is an infection caused by bacteria from the genera *Pasteurella* and *Mannheimia.* Currently, there are 23 different known genera of *Pasteurella,* and of these, only 3 appear to be associated with disease in bighorn sheep, which include *Pasteurella multocida, Mannheimia haemolytica* (aka *P.haemolytica*) and *P.trehalosi*. Within each genera, there are also several known subtypes and many wild mammals such as bighorn sheep and domestic mammals, including sheep and goats, can carry one or more of these bacteria as commensal flora (Miller 2001, U-C Davis 2007).

Exposure of bighorn sheep to domestic sheep and goats carrying those bacteria can have devastating results and examples of epizootic outbreaks of respiratory disease due to contact with domestic sheep or goats exist in the literature (Jessup 1985, Foreyt 1990, Martin et al. 1996, Rudolph et al. 2003). Large population declines in bighorn sheep due to Pasteurella infections have also occurred in the apparent absence of contact with domestic sheep or goats. The cause of those die-offs have been attributed to various forms of stress including overcrowding, poor nutrition, human disturbance, loss of habitat, and competition with domestic and feral animals (DeForge 1981, Spraker et al. 1984, Bunch et al. 1999). Wild sheep to wild sheep transmission is also thought to occur through exposure of naïve bighorn sheep to other bighorn sheep with one of the three genera (Weiser et al. 2003, U-C Davis 2007)

Pasteurella multocida is the most widely distributed of the 3 genera and has been associated with epidemic disease outbreaks in both domestic and wild mammals. *P. multocida* is rarely found or isolated from bighorn sheep and is not typically linked to disease outbreaks. However, it has been associated with large die-offs of Rocky Mountain bighorn sheep in the Hells Canyon area of Idaho, Washington, and Oregon (Weiser et al. 2003) and Colorado (Spraker et al. 1984).

Mannheimia haemolytica and *P. trehalosi* appear to be the genera that primarily affect both wild and domestic ruminants and are the most studied in bighorn sheep. Both can cause pneumonia or septicemia in bighorn sheep; however, they are also considered common commensal organisms in the upper respiratory tract of these animals. As commensal organisms, they likely act as opportunistic pathogens to animals under environmental stress or with lowered immunities (Foryet and Jessup 1982, U-C Davis 2007).

Other contributing factors to respiratory diseases may include other bacteria or viruses such as *Corynebacterium pyogenes* or *Mycoplasma* spp., which may allow for or contribute to pneumonic overgrowth in stressed animals (Spraker et al. 1984). Additionally, parasites such as lungworm can also cause pneumonic outbreak, particularly in lambs, largely affecting recruitment (Foreyt and Jessup 1982, Spraker et al. 1984).

Psoroptic mange is caused by parasitic mites *Psoroptes* spp. and is a contagious skin disease that can affect bighorn populations (Sandoval 1980, Foreyt et al. 1990b). The mite causes pelage to loosen and slough off and extensive lesions to develop in the ears and around the head. For bighorn sheep, this can result in weight loss, loss of hearing and balance, and potentially death through secondary bacterial infections or environmental stress (Lange et al. 1980, Clark and Jessup 1992).

Although unanswered questions remain concerning diseases of bighorn sheep, most wildlife biologists and veterinarians would agree with the following statement: "Until more is known about interspecies transmission of *Pasteurella*, it is absolutely critical that land managers and biologists avoid circumstances that allow domestic sheep and exotic wild sheep to commingle on ranges that harbor viable populations of North American wild sheep" (Bunch et al. 1999).

In 2007, the Western Association of Fish and Wildlife Agencies (WAFWA) Wild Sheep Working Group published the "Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat". Those guidelines clearly outline steps that should be taken by state wildlife agencies, federal land management agencies, wild sheep conservation organizations, domestic sheep and goat producers/permittees, and private landowners to reduce conflicts between wild sheep and domestic sheep and goats.

The Utah Division of Wildlife Resources recognizes the economic importance of the domestic sheep industry, and it is not the intent of this plan or the UDWR to force domestic sheep operators off of their ranges or out of business. Rather, the intent is to look for opportunities that will protect bighorn sheep populations without negatively impacting domestic sheep operators. Recently in Utah, FNAWS has been instrumental in resolving bighorn/domestic sheep issues and has been active in negotiating and funding willing seller buy-outs of domestic sheep grazing permits or conversions of domestic sheep to cattle. Their efforts have resulted in protection of many bighorn sheep populations by reducing the potential for the transmission of disease.

Response and control of a disease outbreak will be conducted using standardized current protocols for sampling and testing (Foster 2004, WAFWA Wildlife Health Committee (WHC), UC-Davis 2007). Accurate cause of death should be determined through a full necropsy when possible. All bighorn sheep that are exhibiting signs or symptoms of illness should be promptly

removed from the population and the impacts of stressors on populations experiencing a disease outbreak should be determined and if possible lessened. The isolation of an affected sheep herd from other unaffected sheep herds should also be ensured.

B. Predation

Predators have played an important role in the evolution and development of adaptive strategies in bighorn sheep (Geist 1999). However, predation can be a serious limiting factor to bighorn herd establishment or expansion. In some states excessive predation has resulted in substantial herd reductions (Wehausen 1996, Creeden and Graham 1997). Mountain lions are the most significant predators of bighorns in Utah. Coyotes and golden eagles may occasionally take bighorn sheep but are not considered to be a serious threat to bighorn sheep herds.

Mountain lion populations should be managed at levels which will allow for the establishment of viable bighorn populations and allow bighorn population objectives to be met. That may require removal of mountain lions which are negatively impacting bighorn populations until herds are well established. Bighorn sheep unit management plans and predator management should specify conditions for predator management in bighorn areas.

C. Habitat Degradation or Loss

Bighorn habitat can be degraded, fragmented, or lost to a variety of causes including human disturbance, mineral development, and natural succession. Reductions in the quality or quantity of habitat can result in corresponding losses to bighorn populations (Deforge 1972, Hamilton et al. 1982).

Human disturbance in bighorn sheep habitat is an increasing concern in many areas of Utah. Those disturbances include outdoor recreation activities such as off-road vehicle use, mountain biking, river running, and others. Bighorn sheep may change use areas and abandon certain habitats because of those disturbances. Human disturbance is also thought to be a possible stress inducer, which may lead to disease problems in some populations (DeForge 1981, Bunch et al. 1999).

Mineral development in bighorn habitat, if not properly regulated and mitigated, can result in direct loss of habitat. Mineral exploration for oil, gas, uranium, and other minerals has been extensive in bighorn areas. Habitat managers for the Bureau of Land Management and U.S. Forest Service need to carefully monitor and regulate those activities to avoid impacts on bighorn sheep.
Plant succession can also dramatically affect habitat quality. Encroachment by pinyon-juniper and other shrubs has resulted in the fragmentation and loss of large expanses of bighorn habitat. Vegetative treatments including fire management can restore and improve bighorn habitat to its condition prior to settlement times.

D. Wilderness and Park Management

Administration of wilderness areas and national parks has presented problems for bighorn sheep

managers in some states (Arizona Game and Fish 1989 and Bleich 1999). Utah currently has a good working relationship with federal land management agencies, which has allowed and promoted good bighorn sheep management programs. Future wilderness designation and park expansions should specifically allow for activities required for proper management of bighorn populations, including the use of aircraft for surveys, transplants, research projects, and the ability to access and maintain water developments constructed specifically for bighorn sheep. It is critical to the future of bighorn sheep in those areas to maintain the use of those valuable management tools.

E. Poaching

Although poaching is not a problem for overall bighorn populations, it can have a detrimental affect on hunter harvest opportunities. Bighorn sheep are highly prized by hunters and legal hunting permits are difficult to obtain. Bighorns often inhabit very remote areas which are difficult to monitor and patrol. Thus, the incentives and opportunities for poaching exist.

F. Competition

Competition for forage and space by domestic livestock, feral animals, and other wild ungulates can impact bighorn populations (Bailey 1980). Competition is most likely to occur in critical habitats such as winter ranges and lambing areas and during periods of extreme weather such as droughts or heavy snow. Competition with livestock for forage is minimal for most bighorn populations in Utah since bighorns utilize steep, rugged terrain generally not used by livestock. However, some feral animals, such as burros and goats, and some wild ungulates may use the same ranges as bighorn sheep making competition possible. Bighorn habitat should be monitored to assure proper range management and minimize competition.

G. Transplants

Transplanting of bighorn sheep is a primary tool for restoration and management of bighorn populations. Several issues should be considered before releasing bighorns in new areas or in existing herds, and those issues are clearly stated in the 2007 WAFWA guidelines (Appendix A). Bighorns should only be released in areas where there is a good probability of success as determined by GIS modeling and habitat evaluations. Sufficient numbers should be released to assure genetic diversity and to help new herds reach self-sustaining levels as soon as possible. Additionally, source stocks should come from the nearest available source with habitat similar to the release site.

Currently, the DWR obtains bighorn sheep for transplants from source herds within Utah as well as surrounding western states and Canadian provinces. As Utah bighorn sheep populations continue to grow, the DWR will work towards transplanting more sheep from Utah populations and reduce the reliance on sheep coming from out of state, with the ultimate goal of only using Utah bighorn sheep populations as source herds for transplants. By doing so, the DWR will minimize the risk introducing a new disease to naïve populations and decrease the chances of having population die offs.

As part of the reintroduction/transplant program within Utah, all bighorn sheep brought into

Utah from other states will be tested for disease and must meet health requirements as established by the Utah Department of Agriculture and the state veterinarian. Additionally, all bighorn sheep relocated within the state will be monitored for those same diseases to prevent the introduction of disease into wild or domestic sheep populations. Moreover, to prevent disease introduction, only healthy wild sheep herds will serve as source stock for intra and inter-jurisdictional transplants. The mixing of wild sheep from various sources will be evaluated and current protocols for sampling, testing, and responding to disease outbreaks will be used as a standard for Utah transplants (Foster 2004, WAFWA Wildlife Health Committee (WHC), UC-Davis 2007).

For all sheep used in relocation, efforts nasal and pharyngeal swabs will be collected to test for *Pasteurella* spp. and blood samples will be collected for brucellosis testing. Sheep used for all relocation efforts will be treated with the appropriate antibiotics, wormers, and vaccinations prior to release. All sheep will be treated with anthelmintics specific to lungworm. Sheep exhibiting signs or symptoms of Psoroptic mange will not be relocated and if the source population is thought to be exposed to Psoroptic mange all sheep with be treated with either injectable or pour-on Ivermectin instead of the anthelmintic. Injectable selenium will be administered to rams and lambs (not to ewes because it causes abortion) to aid in the prevention of capture myopathy. Flunixin meglumine (Banamine) is an analgesic with anti-inflammatory and anti-pyretic properties which should be administered to all animals and long-acting antibiotics will be administered to animals exhibiting signs of unthriftiness. The appropriate vaccinations will be administered as they are developed or when they become available.

IV. USE AND DEMAND

Bighorn sheep are considered one of the most sought after and highly prized big game animals in North America. Demand for bighorn sheep hunting opportunities far exceeds the current availability of hunting permits (Table 3). Currently in Utah, applications exceed available permits by 118:1 for residents and 1,333:1 for nonresidents. Since 1997, hunters have contributed over $2.9 million for bighorn sheep conservation hunting permits in Utah.

Great demand also exists for information concerning bighorn sheep and bighorn viewing opportunities. Many people who have no interest in hunting bighorns are very interested in learning more about bighorn sheep and observing them in the wild. Informational programs and viewing opportunities currently offered for bighorn sheep include DWR sheep viewing days and guided hikes at Antelope Island State Park.

Finally, public interest and legal mandates require management of bighorn sheep for their intrinsic value. Bighorn sheep are an important part of fragile ecosystems throughout Utah and should be properly managed regardless of recreational uses.

V. CONCLUSION

A fitting conclusion to this section of the plan is found in the book *Mountain Sheep of North American* by Raul Valdez and Paul Krausman (1999). It states:

"*Mountain sheep, like all other native fauna and flora, are part of the structure and heritage of North America. Despite all of the efforts exerted toward their conservation, wild sheep face a precarious future. They are an ecologically fragile species, adapted to limited habitats that are increasingly fragmented. Future conservation efforts will only be successful if land managers are able to minimize fragmentation. According mountain sheep their rightful share of North America and allowing them to inhabit the wilderness regions they require is a responsibility all Americans must shoulder. It is our moral and ethical obligation never to relent in the struggle to ensure their survival."*

VI. STATEWIDE MANAGEMENT GOALS AND OBJECTIVES

A. Population Management Goal: Establish optimum populations of bighorn sheep in all suitable habitat within the state.

Objective 1: By 2013, increase the total numbers of Rocky Mountain (including California) and desert bighorns in herds managed by the DWR by 50% and increase all existing herds to at least the minimum viable level of 125 bighorns.

Strategies:

a. Develop management plans for individual units with population goals and objectives (Table 4, Figure 1).
b. Survey all herd units by helicopter every 2–3 years to monitor population size and composition.
c. Utilize population or sightability models to determine the relationship between population surveys and population size.
d. Augment existing populations where needed to improve herd distribution, link small populations, and improve genetic diversity (Table 5).
e. Through coordination with federal land management agencies and GIS modeling, identify areas suitable for bighorn sheep and transplant bighorns to establish new populations (Table 5).
f. Reduce bighorn numbers in specific areas of concentration through trapping and transplanting programs to help reduce potential for disease problems.
g. Develop an annual transplant plan based on available bighorns and consistent with Table 5.
h. Develop an internet based system or statewide database to report, record, and summarize instances of interaction between wild sheep and domestic sheep and goats which allows conflicts to be evaluated and dealt with in a timely manner.
i. Monitor herds periodically for disease and provide treatment if possible.
j. Develop guidelines for dealing with domestic sheep and goats that wander into bighorn sheep units.
k. Participate in research efforts to find solutions to disease problems and low lamb survival and continue research to document and assess the affect of human recreational activities on bighorn populations.
l. Initiate predator management as specified in predator and bighorn sheep unit management plans.
m. Support law enforcement efforts to reduce illegal taking of bighorn sheep.

Objective 2: Manage for a diversity of age classes in the ram segment of each population with at least 30% of the rams 6 ½ years of age or older.

Strategies:

a. Survey all herd units by helicopter every 2–3 years to monitor age class of rams.
b. Recommend conservative ram harvest to assure a diversity of age classes in each hunted population.
c. Monitor size and age class of all harvested rams

B. Habitat Management Goal: Provide good quality habitat for healthy populations of bighorn sheep.

Objective: Maintain or improve sufficient bighorn sheep habitat to allow herds to reach population objectives.

Strategies:

a. Identify critical bighorn sheep habitats and work with land managers and private landowners to protect and enhance these areas.
b. Assist land management agencies in monitoring bighorn sheep habitat.
c. Work with land managers to minimize and mitigate loss of bighorn habitat due to human disturbance and development.
d. Inform and educate the public concerning the needs of bighorn sheep including the effects of human disturbance and the need for habitat improvements.
e. Initiate vegetative treatment projects to improve bighorn habitat lost to natural succession or human impacts.
f. Improve or maintain existing water sources and develop new water sources to improve distribution and abundance of bighorn sheep.
g. Work with land management agencies and private landowners to implement agency guidelines for management of domestic sheep and goats in bighorn areas similar to those proposed by the WAWFA Wild Sheep Working Group.
h. Support conservation group's efforts to pursue buy-outs or conversions of domestic sheep grazing from willing sellers in bighorn areas to minimize the risk of disease transmission.

C. Recreation Goal: Provide high quality opportunities for hunting and viewing of bighorn sheep.

Objective 1: By 2013, increase hunting opportunities by at least 50% while maintaining high quality hunting experiences.

Strategies:

a. Recommend permit numbers based on 12% of the estimated ram population (yearling and older) or 30% of rams 6 years of age or older.
b. Utilize subunits to maximize hunting opportunities and distribute hunters.
c. Recommend long hunting seasons to provide recreational opportunity while avoiding the peak of the rutting season.
d. Maintain hunter success rates of at least 95% on all units.

Objective 2: By 2013, increase public awareness and expand viewing opportunities of bighorn sheep by 100%.

Strategies:

a. Evaluate existing public viewing areas and identify potential new sites.
b. Install interpretive signs in bighorn sheep areas for public information.
c. Produce written guides or brochures to help educate the public and provide viewing opportunities which will not impact bighorn sheep.
d. Continue and expand bighorn sheep viewing events for interested publics.

Table 1. History of bighorn sheep transplants, Utah 1966–2008.

ROCKY MOUNTAIN BIGHORN SHEEP

Unit #	Name of area	# released	Year	Source
1	Box Elder, Pilot Mountain	24	1987	Basalt, CO
		2	1993	Bare Top Mountain, UT
		32	1998	NV
3	Ogden, Box Elder	14	1966	Whiskey Basin, WY
		20	1966	Waterton, AB
		12	1969	Banff, AB
		14	1970	Banff, AB
8	North Slope, Bare Top Mountain	19	1983	Whiskey Basin, WY
		17	1984	Whiskey Basin, WY
		7	2000	Almont Triangle, CO
		3	2001	Basalt, CO
8	North Slope, Sheep Creek	21	1989	Whiskey Basin, WY
		6	2000	Almont Triangle, CO
		1	2001	Basalt, CO
8	North Slope, Hoop Lake	23	1989	Whiskey Basin, WY
8	North Slope, Carter Creek /	10	2000	Almont Triangle, CO
	South Red Canyon	18	2001	Basalt, CO
		6	2003	Desolation Canyon, UT
8	North Slope, Goslin Mountain	34	2005	Thompson Falls, MT
		42	2007	Sula, MT
10	Book Cliffs, Hill Creek	9	1970	Whiskey Basin, WY
		12	1973	Alberta, Canada
		44	1998	Kaleden, BC
		20	1998	Fowler, CO
11	Nine Mile, Bighorn Mountain	26	1993	Estes Park, CO
		28	1995	Georgetown, CO
11	Nine Mile, Jack Creek	15	2000	Bare Top Mountain, UT
		15	2001	MT
16	Central Mountains, Nebo	27	1981	Whiskey Basin, WY
		21	1982	Whiskey Basin, WY
		18	2004	Augusta, MT
		25	2007	Augusta, MT
17	Wasatch Mountains, Timpanogos	25	2000	Rattlesnake, UT
		10	2001	Hinton, AB
		9	2002	Sula, MT
		20	2007	Sula, MT
		18	2007	Forbes, CO
17	Wasatch Mountains, Provo Peak	22	2001	Hinton, AB
		10	2007	Sula, MT / Augusta, MT
19	West Desert, Deep Creek Mountains	16	1984	Whiskey Basin, WY
		14	1989	Whiskey Basin, WY

CALIFORNIA BIGHORN SHEEP

Unit #	Name of area	# released	Year	Source
1	Box Elder, Antelope Island	23	1997	Kamloops, BC
1	Box Elder, Newfoundland Mountains	6	2000	Antelope Island, UT
		16	2001	Antelope Island, UT
		15	2001	Antelope Island, UT
		18	2008	Antelope Island, UT
18	Oquirrh-Stansbury, Stansbury Mountains	12	2005	Antelope Island, UT
		44	2006	Antelope Island, UT
		36	2008	Antelope Island, UT

Table 1. History of bighorn sheep transplants, Utah 1966–2008 (cont.).

DESERT BIGHORN SHEEP

Unit #	Name of area	# released	Year	Source
12	San Rafael, North	12	1979	San Juan Unit, UT
		11	1982	Island in the Sky, CNP, UT
		6	1986	Canyonlands NP, UT
		10	1988	Coal Wash, UT
12	San Rafael, South	12	1983	Island in the Sky, CNP, UT
		16	1984	Potash, UT
		12	1985	Island in the Sky, CNP, UT
		4	1997	Escalante, UT
		6	1998	Escalante, UT
12	San Rafael, Dirty Devil	22	1991	San Rafael, North, UT
		15	1994	Potash, UT
		17	1996	Potash, UT
		25	2003	San Rafael, South, Chimney Cyn., UT
		15	2007	San Rafael, South, UT
		15	2007	Escalante, Steven's Canyon, UT
12	San Rafael, North Wash	21	1996	South San Rafael, UT
		13	1997	Escalante, UT
12	San Rafael, Maze (CNP)	23	1983	Island in the Sky, CNP, UT
		2	1985	Canyonlands NP, UT
13	La Sal, Dolores Triangle	7	1979	San Juan Unit, UT
		20	1990	River Mountains, NV
13	La Sal, Arches National Park	6	1985	Canyonlands NP, UT
		19	1986	Canyonlands NP, UT
13	La Sal, Professor Valley	10	1991	Potash, UT
14	San Juan, North	6	1998	Escalante, UT
		25	1999	Lake Mead, NV
14	San Juan, John’s Canyon	19	2008	San Juan, South, Hite, UT
		11	2008	La Sal, Potash, Crystal Geyser, UT
15	Henry Mountains, Little Rockies	18	1985	Canyonlands NP, UT
25/26	Capitol Reef National Park	21	1984	Island in the Sky, CNP, UT
		10	1985	Canyonlands NP, UT
		20	1996	Island in the Sky, CNP, UT
		20	1997	Island in the Sky, CNP, UT
26	Kaiparowits, Escalante	4	1975	Gypsum Canyon, UT
		12	1976	Gypsum Canyon, UT
		7	1978	Cataract Canyon, UT
		4	1986	Canyonlands NP, UT
		6	1995	Escalante, UT
		7	1998	Escalante, UT
26	Kaiparowits, Rock Creek	20	1980	Cataract/White Canyons, UT
		12	1982	Canyonlands NP, UT
26	Kaiparowits, Rogers Canyon	13	1993	Escalante, UT
		17	1995	Escalante, UT
26	Kaiparowits, Coyote Canyon	21	1995	Black Mountains, AZ
		2	1995	Escalante, UT
26	Kaiparowits, Bowns Canyon	18	1995	Escalante, UT
26	Kaiparowits, Smokey Mountains	21	1999	Lake Mead, AZ
		20	2000	Lake Mead, NV
		20	2006	Fallon, NV
27	Paunsaugunt, Paria River	2	1995	Escalante, UT
		20	1996	Lake Mead, NV
29	Zion National Park	12	1973	Lake Mead, NV
30	Pine Valley, Beaver Dam	25	1994	Lake Mead, AZ

Table 2. Status of existing bighorn sheep populations, Utah 2008.

ROCKY MOUNTAIN BIGHORN SHEEP

Unit #	Unit name	Herd status	Population estimate	Trend
1	Box Elder, Pilot Mountain	Transplanted	30	Stable
8	North Slope, Bare Top Mountain	Transplanted	100	Stable
8	North Slope, Hoop Lake	Transplanted	20	Decreasing
8	North Slope, Sheep Creek/ Carter Creek/South Red Canyon	Transplanted	100	Stable
8	North Slope, Goslin Mountain	Transplanted	125	Increasing
9	South Slope, Dinosaur National Monument	Transplanted	100	Stable
10	Book Cliffs, Rattlesnake	Transplanted	350	Increasing
10	Book Cliffs, Ute Tribe	Transplanted	350	Increasing
11	Nine Mile, Bighorn Mountain	Transplanted	500	Increasing
16	Central Mountains, Nebo	Transplanted	60	Decreasing
17	Wasatch Mountains, Timpanogos	Transplanted	80	Decreasing
17	Wasatch Mountains, Provo Peak	Transplanted	60	Decreasing
19	West Desert, Deep Creek Mountains	Transplanted	25	Stable

CALIFORNIA BIGHORN SHEEP

Unit #	Unit name	Herd status	Population estimate	Trend
1	Box Elder, Antelope Island	Transplanted	190	Increasing
1	Box Elder, Newfoundland Mountains	Transplanted	135	Increasing
18	Oquirrh-Stansbury, Stansbury Mountains	Transplanted	70	Increasing

DESERT BIGHORN SHEEP

Unit #	Unit name	Herd status	Population estimate	Trend
12	San Rafael, Dirty Devil	Transplanted	125	Stable
12	San Rafael, Maze (CNP)	Transplanted	25	Stable
12	San Rafael, North	Transplanted	275	Decreasing
12	San Rafael, South	Transplanted	425	Stable
13	La Sal, Arches National Park	Transplanted	30	Stable
13	La Sal, Dolores Triangle	Transplanted	25	Stable
13	La Sal, Island in the Sky (CNP)	Native	175	Stable
13	La Sal, Potash	Native	230	Increasing
13	La Sal, Professor Valley	Transplanted	25	Stable
14	San Juan, Lockhart	Native	145	Increasing
14	San Juan, Navajo Tribe	Native	125	Stable
14	San Juan, Needles (CNP)	Native	25	Stable
14	San Juan, North	Native	50	Stable
14	San Juan, South	Native	275	Increasing
15	Henry Mountains, Little Rockies	Transplanted	75	Stable
25/26	Capitol Reef National Park	Transplanted	100	Stable
26	Kaiparowits, Escalante	Transplanted	175	Stable
26	Kaiparowits, East / West	Transplanted	200	Stable
27	Paunsaugunt, Paria River	Transplanted	20	Increasing
29	Zion National Park	Transplanted	100	Stable
30	Pine Valley, Beaver Dam	Transplanted	60	Stable

Table 3. Summary of bighorn sheep hunting opportunities, Utah 1967–2007.

Year	Rocky Mountain Bighorns		Desert Bighorns	
	Hunters afield	Rams harvested	Hunters afield	Rams harvested
1967	No hunt	—	9	9
1968	No hunt	—	10	3
1969	No hunt	—	10	6
1970	No hunt	—	10	4
1971	No hunt	—	10	1
1972	No hunt	—	8	1
1973	No hunt	—	No hunt	—
1974	No hunt	—	No hunt	—
1975	No hunt	—	5	2
1976	No hunt	—	10	4
1977	No hunt	—	25	10
1978	No hunt	—	23	7
1979	No hunt	—	18	3
1980	No hunt	—	19	10
1981	No hunt	—	18	5
1982	No hunt	—	11	6
1983	No hunt	—	10	9
1984	No hunt	—	14	5
1985	No hunt	—	15	12
1986	No hunt	—	14	10
1987	No hunt	—	12	7
1988	No hunt	—	15	12
1989	No hunt	—	12	10
1990	No hunt	—	15	12
1991	3	3	13	10
1992	3	3	11	10
1993	6	6	17	17
1994	6	6	19	18
1995	6	6	30	30
1996	6	5	29	28
1997	3	3	29	28
1998	5	5	31	31
1999	4	4	32	31
2000	9	9	33	33
2001	12	12	30	30
2002	13	12	40	39
2003	13	13	44	43
2004	12	12	42	40
2005	13	13	40	39
2006	20*	19*	41	37
2007	22*	22*	45	40

*Includes California bighorn sheep permits.

Table 4. Bighorn sheep management units and region responsible for plan, Utah 2008.

Unit #	Unit name	Subunit name	Region
1	Box Elder	Pilot Mountain	NRO
		Newfoundland Mountains	NRO
		Antelope Island	NRO
8	North Slope	Hoop Lake	NRO
		Sheep Creek	NERO
		Bare Top Mountain	NERO
		Carter Creek/South Red Canyon	NERO
		Goslin Mountain	NERO
10	Book Cliffs	Rattlesnake	SERO
11	Nine Mile	Bighorn Mountain	SERO
12	San Rafael	North	SERO
		South	SERO
		Dirty Devil	SERO
13	La Sal	Potash	SERO
		Professor Valley	SERO
		Dolores Triangle	SERO
14	San Juan	North	SERO
		South	SERO
		Lockhart	SERO
15	Henry Mountains	Little Rockies	SERO
16	Central Mountains	Nebo	CRO
17	Wasatch Mountains	Provo Peak	CRO
		Timpanogos	CRO
18	Oquirrh-Stansbury	Stansbury Mountains	CRO
19	West Desert	Deep Creek Mountains	CRO
26	Kaaiparowits	Escalante	SRO
		East / West	SRO
27	Paunsaugunt	Paria	SRO
30	Pine Valley	Beaver Dam	SRO

Table 5. Potential bighorn sheep transplant sites. Utah 2008.[1]

Rocky Mountain Bighorn

Augment existing populations to meet population management objectives, including:

North Slope, Summit – North Slope Hoop Lake Area*
North Slope, Daggett – Flaming Gorge/Green River
Book Cliffs – Bitter Creek/Willow Creek
Central Mountains, Nebo – Willow Creek
Wasatch Mountains, Timpanogos – American Fork Canyon
Wasatch Mountains, Provo Peak – Rock Canyon

Reintroduction areas to establish new populations:

South Slope, Yellowstone – Uinta Canyon/White Rocks*, Lake Fork/ Yellowstone/Rock Creek*, North Fork of Duchesne River*
South Slope, Vernal – Ashley Creek Gorge/Brush Creek/Dry Fork
South Slope, Diamond Mountain – Diamond Mountain
Book Cliffs, South – Diamond Canyon/ Cottonwood Canyon*
Ninemile, Range Creek – Lower Desolation Canyon, Ninemile Canyon*
Wasatch Mountains, Avintaquin – Indian Canyon/Lake Canyon, Upper Strawberry River/Timber Canyon/Avintaquin Canyon*

California Bighorn

Augment existing populations to meet population management objectives:

Oquirrh-Stansbury – Stansbury Mountains
West Desert – Deep Creek Mountains, Trout Creek

Reintroduction areas to establish new populations:

Fillmore, Oak Creek – Oak Creek Range

Desert Bighorn

Augment existing populations to meet population management objectives, including:

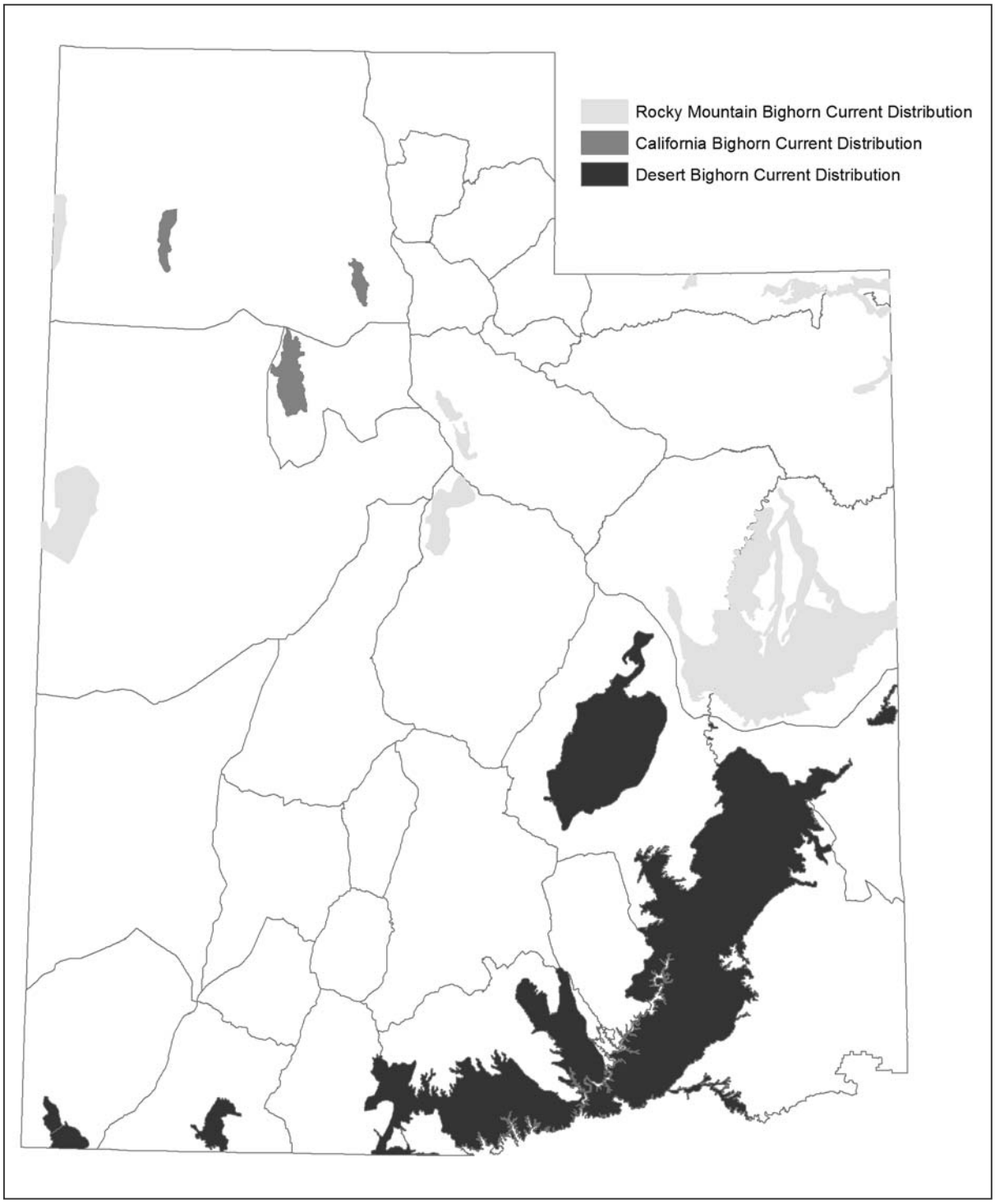
San Rafael, Dirty Devil – Poison Spring Canyon, Maze (CNP)
San Juan – North San Juan
Henry Mountains, Little Rockies – Mount Hillers
Kaiparowits East – Little Valley/Croton Canyon, Last Chance
Kaiparowits West – Heads of the Creeks/Wesses Canyon/John Henry Canyon

Reintroduction areas to establish new populations:

San Rafael, Maze – Orange Cliffs
San Juan – San Juan River (Comb Wash to Grand Gulch), Ticaboo, Good Hope Bay
Kaiparowits East – Cave Point/Sooner Slide

[1] In accordance with Utah Code 23-14-21.
* Designates areas where domestic sheep issues still need to be resolved.

Figure 1. Management units and bighorn sheep distribution, Utah 2008.



Literature Cited

Arizona Game and Fish Department. 1989. Arizona Wildlife Views. September 1989.

Bailey, J. A. 1980. Desert bighorn forage competition and zoogeography. Wildlife Society Bulletin 8:208–216.

Boyce, W. M., and M. E. Weisenberger. 2005. The rise and fall of Psoroptic scabies in bighorn sheep in the San Andreas Mountains, New Mexico. Journal of Wildlife Diseases 41: 525–531.

Bleich, V. C. 1999. Impacts of wilderness management on wildlife conservation: some case histories of conflict. 2nd North American Wild Sheep Conference Proceedings.

Bunch, T. D., W. M. Boyce, C. P. Hibler, W. R. Lance, T. R. Spraker, and E. S. Williams. 1999. Diseases of North American wild sheep. Pages 209–237 *in* R. Valdez and P. R. Krausman, editors. Mountain Sheep of North America. University of Arizona Press, Tuscon, Arizona, USA.

Clark, R. K., and D. A. Jessup. 1992. The health of mountain sheep in the San Andres Mountains, New Mexico. Desert Bighorn Council Transactions 36:30–35.

Creeden, P. J., and V. K. Graham. 1997. Reproduction, survival, and lion predation in the Black Ridge/Colorado National Monument desert bighorn herds. Desert Bighorn Council Transactions 41:37–43.

DeForge, J. R. 1972. Man's invasion into the bighorn's habitat. Desert Bighorn Council Transactions 16:112–116.

_____. 1981. Stress: changing environments and the effects on desert bighorn sheep. Desert Bighorn Council Transactions 25:15–16.

Douglas, C. L., and D. M. Leslie Jr. 1999. Management of bighorn sheep. Pages 238–262 *in* R. Valdez and P. R. Krausman, editors. Mountain Sheep of North America. University of Arizona Press, Tuscon, Arizona, USA.

Foreyt, W. J. 1990. Pneumonia in bighorn sheep: effects of *Pasteurella haemolytica* from domestic sheep and effects on survival and long-term reproduction. Biennial Symposium of the Northern Wild Sheep and Goat Council 7:92–101.

_____, and D. A. Jessup. 1982. Fatal pneumonia of bighorn sheep following association with domestic sheep. Journal of Wildlife Diseases 18:163–168.

_____, V. Coggins, and P. Fowler. 1990. Psoroptic scabies in bighorn sheep in Washington and Oregon. Biennial Symposium of the North American Wild Sheep and Goat Council 7:135–142.

Geist, V. 1971. Mountain sheep: a study in behavior and evolution. University of Chicago Press, Chicago, Illinois, USA.

_____. 1999. Adaptive strategies in mountain sheep. Pages 192–208 *in* R. Valdez and P. R. Krausman, editors. Mountain Sheep of North America. University of Arizona Press, Tuscon, Arizona, USA.

Hamilton, K., S. A. Holl, and C. L. Douglas. 1982. An evaluation of the effects of recreational activity on bighorn sheep in the San Gabriel Mountains, California. Desert Bighorn Council Transactions 26:50–55.

Jessup, D. A. 1985. Diseases of domestic livestock which threaten bighorn sheep populations. Desert Bighorn Council Transactions 29:29–33.

Lange, R. E., A. V. Sandoval, and W. P. Meleney. 1980. Psoroptic scabies in bighorn sheep (*Ovis canadensis mexicana*) in New Mexico. Journal of Wildlife Diseases 16:77–82.

Martin, K. D., T. Schommer, and V. L. Coggins. 1996. Biennial Symposium of the Northern Wild Sheep and Goat Council 10:72–77.

Miller, M. W. 2001. Pasteurellosis pp. 330–339 in Infectious diseases of wild mammals. Iowa State University Press, Ames, Iowa.

Ramey, R. R. 1993. Evolutionary gentics and systematics of North American mountain sheep: implications for conservation. Dissertation, Cornell University, Ithaca, New York, USA.

Rawley, E. V. 1985. Early records of wildlife in Utah. Publication number 86-2. Division of Wildlife Resources, Department of Natural Resources, Salt Lake City, Utah, USA.

Rudolph, K. M., D. L. Hunter, W. J. Foryet, E. F. Cassirer, R. B. Rimler, and A. C. S. Ward. 2003. Sharing of *Pasteurella* species between free ranging bighorn sheep and feral goats. Journal of Wildlife Diseases 39:897–903.

Sandoval, A. V. 1980. Management of a psoroptic scabies epizootic in bighorn sheep (*Ovis canadensis mexicana*) in New Mexico. Desert Bighorn Council Transactions 24:21–28.

Shackleton, D. M., C. C. Shank, and B. M Wikeem. 1999. Rocky Mountain and California bighorns. Pages 78–138 *in* R. Valdez and P. R. Krausman, editors. Mountain Sheep of North America. University of Arizona Press, Tuscon, Arizona, USA.

Shields, W. 1999. Rocky Mountain bighorns - Utah. Pages 108–111 *in* D. E. Toweill and V. Geist, editors. Return of Royalty - Wild Sheep of North America. Boone and Crocket Club and Foundation for North American Wild Sheep, Missoula, Montana, USA.

Spraker, T. R., C. P. Hibler, G. G. Schoonveld, and W. S. Adney. 1984. Pathologic changes and

microorganisms found in bighorn sheep during a stress-related die-off. Journal of Wildlife Diseases 20:319–327.

U-C Davis. 2007. Respiratory disease in mountain sheep: Knowledge gaps and future research. University of California - Davis, Wildlife Health Center. Pp. 1–24.

Valdez, R. and P. R. Krausman. 1999. Description, distribution, and abundance of mountain sheep in North America. Pages 3–22 *in* R. Valdez and P. R. Krausman, editors. Mountain Sheep of North America. University of Arizona Press, Tuscon, Arizona, USA.

Wehausen, J. D. 1996. Effects of mountain lion predation on bighorn sheep in the Sierra Nevada and Granite mountains of California. Wildlife Society Bulletin 24:471–479.

Weiser, G. C., W. J. DeLong, J. L. Paz, B. Shafii, W. J. Price, and A. C. S. Ward. 2003. Charactierization of *Pasteurella multocida* associated with pneumonia in bighorn sheep. Journal of Wildlife Diseases 39:536–544.

Western Association of Fish and Wildlife Agencies Wild Sheep Working Group. 2007. Recommendations for domestic sheep and goat management in wild sheep habitat.

APPENDIX A. WAFWA Wild Sheep Working Group "Recommendations for Domestic Sheep and Goat Management in Wild Sheep Habitat"

Recommendations to WAFWA Agencies

- Historic and suitable unoccupied wild sheep range should be identified, evaluated, and compared against currently-occupied wild sheep distribution for each state/province within the historic range of wild sheep, and also compared against existing and potential areas where domestic sheep and goats are, or may be, authorized.

- Risk assessments should be periodically completed (at least once per decade, more often if situations change) on all existing and potential wild sheep habitat, to specifically identify where and to what extent the wild sheep/domestic sheep and goat interface is located and to monitor changes in risk along that interface.

- Following completion of site-specific risk assessment, wild sheep transplant, augmentation, restoration, and management strategies should be designed to minimize the likelihood of contact between wild sheep and domestic sheep and goats.

- Wild sheep managers should identify, analyze, and evaluate the implications (i.e., both positive and negative) of connectivity and movement corridors between largely insular herds within a meta-population against the opportunity for increased contact with domestic sheep and goats. The benefit of genetic interchange (and implications for population viability) must be weighed against the heightened risk of possible disease transmission (Bleich et al. 1990), especially if dispersing/wandering wild sheep might travel through occupied domestic sheep and goat grazing allotments or trailing routes, or move introduced or locally endemic pathogens from an infected wild herd into a naïve herd.

- Do not transplant wild sheep where there is no reasonable likelihood of achieving effective separation between wild sheep and domestic sheep and goats, unless written agreement to the contrary has been reached between state/provincial wildlife agencies, federal land management agencies, agricultural interests, and wild sheep conservation organizations.

- As potential agricultural conflicts, landscape conditions and habitat suitability change, stocking wild sheep onto historic range, particularly on public lands, should be re-evaluated.

- Wild sheep populations should be managed to reach predetermined population levels (i.e., objectives), and maintained at appropriate densities, to minimize risk of dispersal whereby contact with domestic sheep and goats, and subsequent contact with other wild sheep, is increased. It should be recognized that wild sheep dispersal does occur at all population densities, so some risk is always present if domestic sheep and goats are within range of dispersing wild sheep.

- The higher the risk of contact with domestic sheep and goats, the more intensively that wild sheep herd(s) need to be monitored and managed. Intensity of monitoring should be commensurate with the level of risk and probability of domestic sheep and goat contact when considering "new" vs. "augmented" wild sheep populations. If there are anticipated differences in likelihood of contact with domestic sheep and goats, a site-specific transplant protocol should be spelled out for "new" vs. "augmented" wild sheep populations. For example, the percentage of transplanted wild sheep that should be radio-collared (preferably with GPS collars) should depend upon the subsequent risk of domestic sheep and goat contact. Intensive monitoring allows for documenting the proximity and frequency of interaction between wild sheep and domestic sheep and goats, and also allows for evaluation of post-release habitat use/selection and seasonal/daily movement. It should also be recognized that in some cases, monitoring will be long-term in nature. Budgets to transplant wild sheep should also be adequate to ensure long-term monitoring of transplant success and future wild sheep movements.

- Wild sheep managers should recognize that augmentation of a wild sheep herd from discrete source populations also poses a risk for moving pathogens between wild sheep. Wild sheep management agencies should only use healthy wild sheep herds as source stock for intra- and inter-jurisdictional transplant purposes. Source herds should have extensive health histories and be routinely monitored to evaluate current health conditions. Wild

sheep managers should evaluate tradeoffs between genetic benefits vs. potential health consequences of mixing wild sheep from various source herds when conducting transplants or augmentations.

- If conducting a wild sheep transplant, a map of anticipated wild sheep distribution and movement should be developed prior to the transplant and compared with knowledge of domestic sheep and goat distribution. If a wild sheep transplant occurs, and contact with domestic sheep and goats is confirmed beyond an identified timeframe and/or beyond a mapped geographic area (possibly including historic, suitable wild sheep habitat), domestic sheep and goat producers should be held harmless. Domestic sheep and goat producers outside a pre-defined and mapped wild sheep restoration area, based on expected distribution following a transplant, should not be considered accountable if subsequent contact between wild sheep and domestic sheep and goats occurs or becomes likely.

- Agencies should develop, adopt, and widely distribute a written strategy to address dispersing or wandering wild sheep (British Columbia Ministry of Environment example, Appendix B; Wyoming Game and Fish Department example, Appendix C). These animals may contact domestic sheep and goats, and continue traveling, either back to their source herd, or to other wild sheep herds, with or without infectious disease. This strategy should clearly identify what and when specific actions are to be taken (e.g., kill and medically evaluate wandering wild sheep), and specify who is authorized to take those actions. Furthermore, this strategy should be openly discussed with affected stakeholders, so there is clear and widespread understanding of subsequent management actions by state/provincial wildlife agencies. Some state/provincial wild sheep management plans have already been through considerable public input/review, where this issue has been adequately addressed.

- Agencies should develop a response protocol for confirmed contact between wild sheep and domestic sheep and goats. This strategy should include notification requirements, wildlife health intervention (if appropriate), and post-contact monitoring strategies. Furthermore, state/provincial wildlife and agriculture agencies, land management agencies, industry representatives, and wild sheep advocates should collaborate to develop an effective, efficient, and legal response protocol for errant domestic sheep and goats (e.g, feral, abandoned) for which no owner can be determined and which threaten to come in contact with wild sheep.

- State/provincial wildlife agencies should work together to develop a system (possibly internet-based) to report, record, and summarize instances of interaction between wild sheep and domestic sheep and goats, to track reported contact between wild sheep and domestic sheep and goats, and to avoid loss of anecdotal sightings/reports, Once established, the WSWG website link (http://www.wafwa.org/5.html) would be a logical place to host this incident reporting system. Furthermore, state/provincial and federal wild sheep managers should encourage prompt reporting by the public of observed interaction between wild sheep and domestic sheep and goats.

- The use of domestic sheep and goats as pack animals by hunters, anglers, and other recreational or commercial users that travel in mapped wild sheep habitat should be prohibited where legislation/regulation exists. Where legislation/regulation is not in place, an effective outreach/education program should be implemented to inform potential users of the risks associated with that activity and recommend that individuals do not use domestic sheep or goats as pack animals.

- Wild sheep managers should coordinate with local Weed & Pest Districts or other appropriate agencies/organizations involved with weed management to preclude the use of domestic sheep and goats for noxious weed control, in areas where contact between wild sheep and domestic sheep and goats is likely to occur. Agencies should provide educational information and offer assistance to Weed & Pest Districts regarding the disease risks associated with domestic sheep and goat use. Specific guidelines have been developed by, and implemented in, British Columbia (http://www.for.gov.bc.ca/hfp/publications/00006/).

- Several capture and disease-testing protocols (pre-transplant, post-dieoff) have been developed and/or drafted and are available to wild sheep managers (Foster 2004, WAFWA Wildlife Health Committee (WHC), UC-Davis 2007). Specific protocols for sampling, testing for transplant, and responding to disease outbreaks are necessary and should be standardized across state and federal jurisdictions. These protocols should be reviewed and updated if necessary by the WHC and presented to the WAFWA Directors for final endorsement. Once

endorsed by the WAFWA Directors, wild sheep management agencies should implement the existing protocols, and the WHC should lead the effort to further refine and implement said protocols.

- Wild sheep management agencies should coordinate and pool funding and resources to support laboratories and testing facilities with expertise in various facets of wild sheep disease diagnostic work. Furthermore, state and provincial wild sheep managers should support efforts on data sharing, development and use of standardized protocols for assessment of wild sheep herd health status. Inter-agency communication between wildlife disease experts should be encouraged, to synergistically accomplish more than individual agencies or organizations are capable of by themselves.